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Severe Traumatic Brain Injury, Frontal Lesions, and Social Aspects of Language Use: A Study of French-Speaking Adults

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Abstract

The purpose of this study was to gain insight into the social (pragmatic) aspects of language use by French-speaking individuals with frontal lesions following a severe traumatic brain injury. Eleven participants with traumatic brain injury performed tasks in three areas of communication: production (interview situation), comprehension (direct requests, conventional indirect requests, and hints), and metapragmatic knowledge. The results of the patients pointed out some strengths (turn-taking in production, and request comprehension, including hints and the speaker's intention) and some weaknesses (topic maintenance in production and metapragmatic knowledge). The patients' good comprehension of requests and their difficulty expressing metapragmatic knowledge suggests that they differ from controls in how they "explain the world": their knowledge of the event sequence was not based on verbally expressible knowledge about the relationship between the structural characteristics of a request utterance and those of its social production context. The pragmatic skills of persons with traumatic brain injury seem to vary across tasks: these individuals have specific strengths and weaknesses in different domains. In addition, marked interindividual differences were noted among the patients: three of them had only one weak point, topic maintenance. These interindividual differences were not systematically linked to performance on executive function tests, but lesion unilaterality (right or left) seems to help preserve patients' pragmatic and metapragmatic skills. The discussion stresses the need to take each patient's strengths and weaknesses into account in designing remediation programs.

Keywords: Severe traumatic brain injury; Frontal lesion; Pragmatics; Metapragmatics; Language Production; Language Comprehension; Requests; Communication

1. Introduction

Within the past twenty years or so, the theoretical concepts defined in pragmatics (Austin, 1962; Bernicot, 1994; Grice, 1975; Noveck & Sperber, 2004; Searle, 1969; Verschueren, 1999) have gained importance in research on the neuropsychology of language or "neuropragmatics". Our understanding of the neural bases at play in the domain of language pragmatics has improved considerably, and increasingly accurate investigations in this area are being conducted. Whereas left-brain lesions are likely to cause aphasia, right-brain lesions are more likely to lead to social interaction problems, particularly in the use of language in context (the patients reported in the literature usually have unilateral focal lesions). These patients may experience difficulty not only in communicating in an appropriate manner (Brady, Armstrong, & Mackenzie, 2006; Gardner, 1976; Joanette, Goulet, & Hannequin 1990; Myers, 1999) but also in making use of the contextual information required for grasping the speaker's intention (Brownell, Potter, Bihrle, & Gardner, 1986; Champagne, Desautels, & Joanette, 2004; Chantraine, Joanette, & Ska, 1998). Persons with frontal lesions may have communication problems too (Channon & Crawford, 2000; Martin & McDonald, 2003; McDonald & Pearce, 1996; Pearce, McDonald & Coltheart, 1998). This field of research — in which language use is a key area of investigation — has relied extensively on the study of head-injured patients (the literature reviewed in our paper includes participants with traumatic brain injury). The presence of a frontal lesion following a traumatic brain injury is common (Penn, 1999). Individuals having undergone a traumatic brain injury often have substantial social-adaptation problems in their daily lives, as well as difficulty with the pragmatic (social) aspects of language (Biddle, McCabe, & Bliss, 1996; Brooks, Campsie, Symington, Beattie & McKinlay, 1986; Brooks, 1984; Levin & Kraus, 1994; Martin & McDonald, 2003; Van Leer & Turkstra, 1999).

Clinical observations and early research in this field suggest that many people with traumatic brain injury often use language in an inappropriate way in interaction contexts, although the morphosyntactic and phonological components of language seem to be spared. These findings raise a number of questions about the role of the frontal lobes in language, and they have rekindled an interest both in the nature of cognitive processing

during speech and in the location of the underlying brain structures. The goal of the present study is to further our insight into these questions by analyzing with the same participants, three areas of performance in patients with traumatic brain injury and frontal-lobe lesions: production (in an interview situation), comprehension (of requests), and metapragmatic knowledge (i.e., understanding of the social aspects of language use).

In relation to past research, our contribution deals essentially with three points. Firstly, having the same group of participants perform three different tasks will allow us to determine whether and to what extent the pragmatic deficit of brain-damaged patients is homogeneous (i.e., affects all tasks), and whether they can be shown to have any specific strengths and weaknesses in these domains. We will also analyze their individual differences, an area that has hardly been studied in the research conducted to date. Secondly, request comprehension (not only conventional indirect requests but also hints) will be assessed using a stricter criterion than in earlier studies: rather than the participants' understanding of the action to be carried out (standard criterion) we use their understanding of the speaker's intention. Thirdly, a detailed analysis of metapragmatic knowledge will allow us to determine whether patients with traumatic brain injury have more than just an apparent understanding of requests, but are also able to explain social language functioning as well as control participants can. We define metapragmatic knowledge as knowledge about social uses of language — such as how utterance forms fit with situational characteristics, the intentions of interlocutors, and so on — that can be expressed verbally, outside of a communication situation (Bernicot, 1991).

Moreover, it should be noted that studies concerning the social aspects of French language use by people with traumatic brain injury are scarce. This line of research should be developed in an international research context, in view of both creating assessment instruments — which are virtually nonexistent in this field — and improving therapy for French-speaking patients. Most investigations conducted so far have evaluated English- or Italian-speaking patients. Given that the rules of conversation and the indirect forms studied here operate in an analogous way in French, English, and Italian, we do not expect to find major cross-linguistic differences. The results of our study will enlarge the available knowledge in this field by adding data from a new language.

By comparing production, comprehension, and metapragmatic knowledge, we should be able to determine whether the population of patients with traumatic brain injury has uniform difficulties on these three tasks, or strong and weak points that differ across tasks. A patient-by-patient comparison will also allow us to find out if they have marked interindividual differences and performance profiles. Concerning our three tasks, we know firstly that typical adult performance is optimal (or nearly optimal) on these tasks (Bernicot & Dardier, 2001; Bernicot, Dardier, Fayada, Pillon, & Dubois, 2001), and secondly that, from the developmental standpoint, comprehension is acquired earlier in childhood than production and metapragmatic knowledge (Berko-Gleason, 2001). These findings must be taken into account in interpreting patient performance.

Looking at interindividual differences is crucial for treating patients because it allows the therapist to concentrate on those domains that have been affected the most. Furthermore, the materials used in fundamental research can open up avenues for the development of remediation tools for treating disorders in social language use. Normalized tests exist for English (such as *The Awareness of Social Inference Test* or *TASIT* designed by McDonald, Flanagan, & Rollins, 2002) but remain rare for French (*e.g., Protocole Montreal d'Evaluation de la Communication or MEC* by Joanette, Ska, & Côté, 2004). Further studies in this domain are therefore needed.

1.1 Pragmatic and Metapragmatic Disabilities

Four main areas of language processing have been studied in individuals with traumatic brain injury: conversation, request comprehension, more rarely, metapragmatic knowledge, and link between pragmatic skills and executive functions. Prior research has dealt mostly with English-speaking patients, with a few exceptions for Italian and French.

Conversation. Prutting and Kirchner (1983) and Linscott, Knight, and Godfrey (1996) used pragmatic scales (observation grids for practitioners) to point out the existence of a variety of conversation disorders in individuals with traumatic brain injury, including difficulty choosing and changing topics, problems with turn-taking, and poor management of the paralinguistic aspects of discourse (intonation, loudness, fluency) (see also Mentis & Prutting, 1991; Milton, Prutting & Binder, 1984; Penn & Cleary, 1988).

Togher, Hand, and Code (1997) and Togher and Hand (1999) analyzed telephone conversations (with different interlocutors, e.g., a bus driver, a policeman) and showed that patients differed from control participants by the greater familiarity in their speech, their incomplete or repetitive replies, and their slowness in providing the information needed to be understood by their interlocutor. Bond and Godfrey (1997) showed that unlike control participants, patients participating in free conversations spoke little, did not pursue the topics addressed, and did not show an interest in the other person's point of view, resulting in the need for the experimenter to intervene frequently in order to keep the conversation going. According to Snow, Douglas, and Ponsford (1995), the interlocutor's attitude and his/her use of "semi-structured" utterances to speak to patients can mask their potential difficulties and allow them to produce relatively well-structured discourse (albeit not very elaborate). Bernicot and Dardier (2001) showed that persons conversing with such patients had to intervene regularly and had to adopt various conversational strategies to ensure exchange continuity. The results obtained by Angeleri, Bosco, Zettin, Sacco, Colle, and Bara (2008) in their recent study with Italian participants showed that patients were able to maintain the structure of the exchange in short conversations about simple topics (leisure activities, favorite TV show, memories about recent vacations, talking about the patient's city of residence or home). On the other hand, these same authors noted that the patients had trouble changing topics and tended to persevere with topics previously brought up.

Request comprehension. In pragmatics, requests are "directive" speech acts, which Searle (1969) defined as social acts by way of which a speaker attempts to get a listener to do something. There are various types of requests, including direct requests (commands in the imperative, such as "Close the window") and conventional indirect requests (questions of the embedded imperative type "Can you close the window?"). In the latter case, there is a discrepancy between "what is said" (which calls for a yes or no answer) and "what is meant" (which calls for the execution of the action of closing the window); the listener must therefore infer the speaker's intention from contextual cues (Bernicot, Laval, & Chaminaud, 2007). Embedded imperatives are commonly used as directives: among typical adults, and even out of context, embedded imperatives are very

rarely interpreted as a question about whether the listener is capable of carrying out the action.

Research on the comprehension of requests has shown that a large majority of individuals with traumatic brain injury do not have trouble understanding this type of utterance. In general, the type of request tested is *conventional indirect requests*, i.e., embedded imperatives of the type "Can you make me a cup of coffee?" (Angeleri et al., 2008; Bara, Tirassa, & Zettin, 1997; McDonald, 1992). Concerning the methodologies used, the focus has mainly been on the participant's comprehension of the action requested of the listener. In the study by McDonald (1992), the participants had to say whether the listener's responses (either "action" responses or verbal "yes" responses) were appropriate. In Bara et al.'s (1997) research, comprehension of conventional indirect requests was tested in two ways: in an oral conversation (the experimenter made indirect requests of the type "Can I have that video?" and in writing (reading an exchange between two interlocutors). The results of both studies (Bara et al., 1997; McDonald, 1992) showed that patients had no trouble understanding conventional indirect requests. In the recent study by Angeleri et al. (2008), request comprehension was tested using a task where the experimenter produced requests and commands, and the participant had to carry them out. Once again, this type of conventional request did not pose any comprehension problems for the patients. As we have seen earlier, patients may show the ability to understand these requests if the utterances are presented in contexts that facilitate access to their nonliteral meaning. In head-injured individuals, this type of inferential processing may therefore be spared, and this could account for their ability to understand simple indirect forms (Bara et al., 1997). Other studies suggest, however, that these persons have trouble with utterances requiring more complex inference-making. A case in point is sarcasm. McDonald (1999) spoke of "failure of inferential reasoning", and also stressed that comprehension can depend not only on the form of sarcasm under consideration, but also on the available contextual information and the experimental paradigm used.

There are very few studies on how well people with traumatic brain injury understand *unconventional indirect requests or hints* (saying "It's cold" to mean "Close the window"). To understand a hint, the listener must make inferences that are more

complex than those needed for embedded imperatives. The studies by McDonald and Van Sommers (1993) and McDonald and Pearce (1998) showed that patients had trouble formulating such highly indirect requests in certain situations: for example, at a gathering of friends, how to suggest to someone that it's his turn to pay for a round of drinks (McDonald & Van Sommers, 1993), or how to convince your sister to lend you her car tonight when you know she's planning on using it herself (McDonald & Pearce, 1998).

Metapragmatic knowledge. In the research on neuropragmatics, very few studies have looked into metapragmatic knowledge, i.e., the ability to verbally express the rules governing the social aspects of language use, such as the politeness of a request, its linguistic form, or its content as a function of the interlocutors' status, the appropriateness of an utterance in a given communication situation, etc. Yet as noted above, taking metapragmatic knowledge into account (in terms of explanations given for response choices in a comprehension task) should shed new light on patients' "explanations of the world" and especially, on their ability to infer the speaker's intention from the utterance produced and the communicative context. The capacity to grasp the mental states of others and to interpret or predict their behaviors is studied in theory-of-mind research (Baron-Cohen, Leslie & Frith, 1985; Premack & Woodruff, 1978). Analyses of the abilities of head-injury patients in this domain (Bibby & McDonald, 2005; Havet-Thomassin, Allain, Etcharry-Bouyx, & The Gall, 2006; Henry, Phillips, Crawford, Ietswaart, & Summers, 2006; Muller, Simion, Reviriego, Galera, Mazaux, Barat, & Joseph, 2009) have pointed out deficient attribution of mental states, an impairment that can have negative repercussions on indirect language comprehension (Champagne-Lavau & Joanette, 2009; Channon, Pellijeff, & Rule, 2005; Martin & McDonald, 2005). According to a study by Channon et al., (2005), head-injured patients may exhibit some ability to understand sarcasm, but they differ from control participants in their lesser ability to express social knowledge about the use of sarcasm. In the present study, our assessment of request understanding (pragmatic aspects) is systematically supplemented by an evaluation of the patient's metapragmatic knowledge about how verbal requests function. This should allow us to determine — as in the Channon et al. (2005) study — whether head-injured patients have more difficulty with the metapragmatic facet than with the pragmatic facet of language use.

Link between pragmatic skills and executive functions. As stressed by Channon and Watts (2003), a question worth raising concerns the link between pragmatic skills and executive functions, both of which are impaired by frontal lesions. According to a recent review by Douglas (2010), whereas most studies tend to show that executive dysfunction is associated with pragmatic impairment, the strength of the association remains weak if we consider the entire set of correlation studies conducted to date. This observation suggests caution in interpreting any results found. Lastly, for Douglas (2010), there are several other parameters that limit the generality of the results, including the wide variety of pragmatic tasks proposed (conversing, storytelling, requesting, etc.), the small number of patients tested, population diversity (characteristics of the lesion, presence of front-brain damage, severity of traumatic brain injury, time since injury), and the neuropsychological tests used.

As already stressed, frontal lesions are a frequent consequence of a traumatic brain injury. Despite this fact, the presence of such lesions (in the majority of patients selected) is only mentioned in two studies on conversation (Angeleri et al., 2008; Bernicot & Dardier, 2001) and in four studies on request understanding and metapragmatic knowledge (Angeleri et al., 2008; Bara et al., 1997; Channon et al., 2005; McDonald & Pearce, 1998). Although few researchers have taken into account or even mentioned the type of lesion in head-injured patients, there are two studies (Alexander, Benson, & Stuss, 1989; Kaczmarek, 1984) that describe the pragmatic disorders of unilateral focal frontal-lesioned patients (left or right focal damage after stroke). We can see a number of similarities between the production disorders described in their patients and those classically observed in many persons with traumatic brain injury.

1.2 Research Goals and Questions

The purpose of this study is to make a comprehensive assessment of communication in individuals with severe traumatic brain injury and frontal lesions, as compared to typical adults, on three types of tasks administered to all participants: (1) an interview (production), (2) a verbal-request comprehension task for various types of requests, and (3) a response-explanation task for assessing metapragmatic knowledge.

The data from this study on French-speaking participants are analyzed in relation to the more abundant data already obtained for English and Italian. Clyne (1998) synthesized cross-linguistic (and cross-cultural) differences in discourse organization and speech acts. For the level we are analyzing here, nothing allows us to predict any major differences between the three languages in terms of the turn-taking structure or the functioning of direct and indirect requests. As stated above in the introduction, the present study falls into a tradition that is old, yet still a current topic in language pathology: for an English/German comparison**,** see Van Daal, Verhoeven, & Van Balkom (2004); for an English/Italian/French comparison, see Reilly, Bernicot, Vicari, Lacroix, & Bellugi (2004). Our goal is to expand the research already conducted in English and Italian in view of strengthening the findings in the field of pragmatics and metapragmatics and permitting cross-language comparisons. In addition, the French data we obtained using new criteria to assess request comprehension and metapragmatic knowledge should pave the way for later research in other languages.

Again, our aim is to compare the performance of participants on different tasks that call upon pragmatic abilities acquired gradually during development. Based on this initial idea, we try to find out whether the population of persons with traumatic brain injury exhibits uniform pragmatic skills (irrespective of any deficiencies) or whether some domains are more sensitive than others to a brain injury. More specifically, our goal for *production* is to determine whether and to what extent participants are capable of following the rules (the script) of a particular language register: the interview. The question raised is: To what extent is the structure of the exchange maintained while the management of the topic of conversation (in terms of digressions) is impaired? For *comprehension*, we tested participants' understanding of an important speech act in everyday life: the request. Request comprehension is assessed as a function of the linguistic form. Acknowledging the fact that these patients exhibit a good understanding of conventional indirect requests, what results we obtain if we (a) change the comprehension criterion (action to be carried out/speaker's intention), and (b) increase the indirectness of the requests by studying the comprehension of unconventional indirect requests (hints)? For *metapragmatic knowledge*, our goal is to determine whether participants are capable of thinking explicitly about the relationship between linguistic

forms and communication situations. Like all linguistic skills, pragmatic abilities do not form a homogeneous whole, so it is necessary to assess each component separately. Based on earlier studies, our first aim here is to answer the following question about traumatic brain injured patients with frontal lesions: To what extent do these individuals experience greater difficulty with the metapragmatic facet of language than with the pragmatic facet?

A full evaluation of the pragmatic and metapragmatic facets should allow us to determine not only *the patients' weak points but also any potential strengths*. Angeleri et al. (2008) showed that the structure of exchanges with others (i.e., the turn-taking process) was spared in traumatic brain injured patients. In addition, past research has indicated good comprehension of conventional indirect requests (Angeleri et al., 2008; Bara et al., 1997; McDonald, 1992). Thus, a better understanding of the pragmatic and metapragmatic skills of these patients is likely to be very useful in developing more effective remediation programs.

We also define several patient profiles by analyzing their *interindividual differences*. In conversation some patients exhibit verbal fluency despite their highly disorganized discourse (Martin & McDonald, 2003), whereas others exhibit a more impoverished discourse, both in quantity and in quality (Linscott et al., 1996). Clinical observations suggest that disabilities following a traumatic brain injury vary as a function of lesion site and size, brain-damage severity, and other factors such as the patient's age, past performance levels, and the presence of associated disorders. The frequent presence of frontal lesions caused by a traumatic brain injury (Levin & Kraus, 1994) must be taken into account in analyzing the communication deficits of these patients (McDonald, 1993). Even though anatomical data is difficult to use (given the diffuse aspect of the lesions) and is not often specified in the literature, frontal-lobe damage and lesion side should be brought to bear in defining the pragmatic profiles of patients.

Finally, patients with traumatic brain injury often have executive dysfunctions considered to be partially linked to their pragmatic and metapragmatic skills (Douglas, 2010; Channon & Watts, 2003). To study the strengths and weaknesses of individuals with traumatic brain injury and their interindividual differences, we use an experimental approach based on the simultaneous analysis of the participants' characteristics (age, time

since injury) and their pragmatic, metapragmatic, lesional, and neuropsychological profiles.

2. Method

In order to achieve a complete evaluation of the pragmatic and metapragmatic skills of the patients and control participants, we had them perform three tasks: (1) a production task (interview), (2) a task aimed at assessing their request comprehension, and (3) a metapragmatic knowledge task for different types of verbal requests. The experimental and control populations (hereafter called patients and controls, respectively) were the same in the three tasks. All tasks were administered orally and individually. The pragmatic and metapragmatic testing lasted an average of 30 minutes. The participants are presented here in Section 2; Section 3 gives the information and results for production; Section 4 reports the information and results for comprehension and metapragmatic knowledge.

The patients were seen at the hospital (nine patients) or in their homes (two patients); the controls were seen in their homes. The tasks were administered in the same way in all cases and the experimenter had not met with any of the participants beforehand. The test sessions were tape-recorded for later transcription and coding. The patient sample is described in Table 1; it was composed of eleven participants (ten men and one woman) ages 18 to 49 (M = 33.6 years, SD = 10.77) with a severe traumatic brain injury (initial Glasgow Coma Scale rating of eight or less). Nine patients were recruited at the Language Center of Pitié Salpétrière Hospital in Paris and two were selected at the Saint-Maurice National Hospital in the Parisian area. All patients were native speakers of French and gave their written informed consent to participate in the study. The time between the traumatic brain injury and the testing period was at least two years for all patients (M = 6.72 years, SD = 4.22). Their educational level ranged from "less than high school" (five patients) to "PhD" (two patients), with two levels in-between: "high school diploma" (three patients) and "some university" (one patient). None had sight or hearing problems that could have hindered task execution. The control

group was made up of eleven persons with no known history of psychiatric or neurological disorders. Each patient was matched to a control participant on age, gender, handedness, and education.

Insert Table 1

Having neuropsychological assessments of patients is critical for interpreting their results on pragmatic and metapragmatic language tasks. On the cognitive level, the patients' scores on the MMSE (Mini Mental State Evaluation: Folstein, Folstein, & McHugh, 1975) indicated overall spared abilities for every patient (cutoff point: 25 out to 30). The language tests generally used to diagnose aphasia (French version of the Boston Diagnosis Aphasia Examination by Mazaux & Orgogozo, 1981; Deloche & Hannequin's oral naming task "DO80", 1997) indicated no language impairment. The patients' results on four tests assessing executive functions are given in Table 2. The four tests were (1) *Phonemic Fluency* (Miller, 1984), which detects executive dysfunction in terms of both mental flexibility and self-regulation (Henry & Crawford, 2004); (2) a modified version of the *Wisconsin Card Sorting Test* (Nelson, 1976), which evaluates conceptual capacities, the ability to keep to the current rule, and mental flexibility; (3) *the Stroop Test* (Stroop, 1935), which assesses inhibition ability; and (4) *the Trail Making Test* (Reitan, 1958), which also evaluates mental flexibility. For executive functions, the patients were not overly deficient but exhibited interindividual differences: three of them had no deficiency at all (patients P7, P8, and P10), four were impaired in only one test out of four (patients P1, P5, P6, and P9), one had problems in two tests (patient P4), and another had trouble in three tests (patient P2). Patients P3 and P11, whose scores were not available on one or two tests, were deficient in at least one test.

Insert Table 2

3. Production Task: The Interview

As stated above, production was assessed via participation in an interview (as the interviewee). From the pragmatic standpoint, this task involves being capable of following the rules of this language register, particularly in terms of taking the floor on one's turn and keeping to the topic of conversation. These are pragmatic skills, just like those elicited in the other tasks in our battery (comprehension and metapragmatic knowledge), but they concern a different, complementary component of those skills.

3.1 Procedure

After a brief introduction, the experimenter initiated a conversation about the participant's leisure activities and tastes. The experimenter was trained in how to conduct the interviews (Bernicot & Dardier, 2001) and was told to act the same way with each participant. The experimenter's ability to abide by the interviewing rules with each participant were validated in advance by independent judges based on transcriptions of the training interviews. The interviewing instructions were to let the participants express themselves freely on the topics chosen, without intervening, and to prompt them only if they were silent for more than three seconds. The prompts consisted solely of requests for specifics on the points brought up by the participant. The two topics addressed during the interviews were very ordinary topics of conversation (related to everyday situations) that we thought would be interesting and relevant to persons of all ages: the participant's favorite animals and favorite singers. The topics were brought up using open-ended questions: "What are your favorite animals/singers and why?" The reason for choosing these two topics was that we had already used them in an earlier study on head-injured adolescents and young adults with frontal lesions (Bernicot & Dardier, 2001). Moreover, the subject of tastes in music has been used in other work on adolescent conversation analysis (Turkstra, 2001).

The interview ended when the participants indicated that they had nothing else to say. For the most verbose participants, the experimenter stopped the interview after 16 minutes.

3.2 Data Coding

Three types of indexes were used: speech quantity (speaking turns and utterances), topic maintenance, and digressions. Coding was done by two independent coders for 10% of the corpus. Interview length varied across participants: as a whole, the patients' conversations were shorter than those of the controls (mean length for patients: 11 minutes, range 6 to 16 min.; mean length for controls: 15 minutes, range 10 to 16 min.). In order to have the same amount of speech for each group, we retained only the beginning of each control participant's conversation, for a duration equal in length to that of the corresponding patient's entire conversation.

Speech quantity. The conversations were transcribed and segmented into speaking turns and utterances. A speaking turn ended whenever one or both of the following events occurred: a change of speaker, or a pause of more than two seconds (Sacks, Schegloff, & Jefferson, 1974). The inter-coder agreement rate was .81 (number of speaking turns coded in the same way, divided by the total number of speaking turns). The utterances in each speaking turn were delineated by a terminal juncture or a paraverbal behavior (such as laughter). Terminal juncture was identified on the basis of the following phonetic characteristics (Halliday, 1975): (a) a terminal contour (falling, rising-falling) and (b) a steady intonation pattern followed by vocal arrest (inter-coder agreement rate: .80).

For each participant, we calculated the number of speaking turns and the number of utterances per minute (since the conversations varied in duration across participants).

Example of speaking turns and utterances (utterances are shown in boldface)

Experimenter: **And birds in general?** (speaking turn containing one utterance)

Participant: **Well, yes, small birds are quite cute. Little sparrows are adorable. They're adorable. But in nature, all animals are magnificent anyway even a hippopotamus has a beauty of its own.** (speaking turn containing four utterances)

Topic maintenance. The topic-maintenance index was used as a measure of the patient's ability to develop a topic of conversation. We decided to measure this capacity at a particularly significant moment of the exchange, namely, when speech was resumed

after a silent period. During an interview, it can happen that the interviewee stops talking. Two cases are possible:

a) The participant was silent for three seconds, so the interviewer prompted him/her, as in the example below about favorite animals (utterances are shown in boldface).

Experimenter: **And do you like all kinds of dogs?**

Participant: **Mostly big dogs**. (3-second pause)

Experimenter: **And what breeds of dog, for example?**

Participant: **Big ones. Like German shepherds.**

(After the original silent period and the experimenter's prompt, the participant continued to talk about this topic.)

b) The participant paused for less than three seconds and then started talking again by expanding upon the interview topic, without experimenter intervention (see examples below). This was the type of speaking turn we analyzed here.

<u>Example of two consecutive topic-maintaining speaking turns without experimenter intervention, on the topic of favorite singers (utterances are shown in boldface)</u>

Experimenter: **What about Lou Reed, what do you like about him?**

Participant: **Lou Reed?** (2-second pause)

Participant: **Uh, I well, um, really the poetry in the words - it's the words - I don't think he's that great from the musical point of view - although I've seen him often - I've seen him several times in concert.** (speaking turn with topic of patient's preceding turn maintained)

Topic maintenance was analyzed within speakers on the basis of the number of speaking turns during which the participant talked about the main topics of the conversation (favorite animals and singers) without experimenter intervention (inter-coder agreement rate: .95). This index served to check for an important rule in interviewing, exchange continuity, i.e., the interviewee's ability to develop a topic over

several consecutive speaking turns without prompting. For each participant, the percentage of topic-maintaining speaking turns was calculated by dividing the number of turns in which the topic was maintained without experimenter intervention, by the total number of speaking turns for that participant (which varied across participants). This was not a measure of all occurrences of topic maintenance, but solely those occurrences where continuity was particularly difficult to achieve: i.e., after a silence.

Digression. A digression occurred whenever a production was not directly related to the current topic of conversation. The digression index of each participant was calculated by dividing the number of speaking turns containing a digression, by the total number of speaking turns for that participant (inter-coder agreement rate: .92).

Example of a speaking turn containing a digression, for the topic "favorite singers" (utterances are shown in boldface)

Experimenter: W**hat do you like about her** (Janis Joplin) **?**

Participant: **I remember how I had made some drawings when I was in art school - while listening to the music I had made some drawings while listening to the music - I had made some drawings you know some little sketches as I listened - you listen to music and you draw at the same time about Janis Joplin - I had made a - I had made a stain - I had made the drawings while sketching very fast like crazy and all along you reduce it to a plane - you condense a little piece of time you know into a two-dimensional picture - it's about how to transfer a universe of time onto a two-dimensional plane.** (speaking turn containing a digression)

3.3 Results

Figure 1 gives the mean number of utterances and speaking turns per minute for the two groups (patients and controls). We analyzed both the productions of the participant speaking to the experimenter, and the productions of the experimenter speaking to the

participant. For each dyad, then, we had two values, one for the participant and one for the experimenter.

The statistical analysis (Mann-Whitney U) did not yield an effect of the group factor on either dependent variable (for the participants or for the experimenter). Converting these per-minute results into values corresponding to an interaction lasting an average of 10 minutes, we obtained approximately 35 to 45 speaking turns containing 3 or 4 utterances each for the participants, and 30 to 40 speaking turns containing only one utterance each for the experimenter. The participants produced more utterances than the experimenter in both groups (sign test) (patients: $z = 3.02$, $p < .003$; controls: $z = 3.02$, $p < .003$). For speaking turns, this difference was only found for the control group ($z = 2.41$, $p < .02$).

Insert Figure 1

Figure 2 gives the percentage of topic-maintaining speaking turns without experimenter intervention and the percentage of speaking turns containing a digression. Again, the percentage of topic-maintaining speaking turns did not take all occurrences of topic maintenance into account but only those where the topic was particularly difficult to maintain because of the silent period (see 3.2, Data Coding). The fact that a participant is able to expand upon the interview topic during a series of speaking turns in which he/she pauses but is not prompted by the experimenter reflects the ability to autonomously follow the rules governing this type of situation. The statistical analysis showed that patients produced fewer topic-maintaining speaking turns than the controls did ($U = 9.50$, $p < .0009$). The patients also produced more speaking turns containing a digression than the control participants did ($U = 25.5$, $p < .02$). Compared to the controls, the patients stuck to the topic of conversation four times less often and digressed more than 10 times more often. Converting these percentages into values corresponding to a 10-minute interaction, we obtained 6 or 8 topic-maintaining speaking turns for the controls versus 1 to 2 for the patients, and 2 or 3 digressing speaking turns for the patients versus 0 (in most cases) or 1 for the controls.

Insert Figure 2

4. Comprehension and Metapragmatic-Knowledge Task for Different Types of Verbal Requests

Here, we test the hypothesis that patients will experience more difficulty in analyzing certain kinds of indirect requests. To do so, we defined a comprehension criterion for evaluating the understanding of unconventional indirect requests that could assess complex inferential processing. In past research, the criterion used for indirect requests was the action accomplished right after the request utterance. Bernicot and Legros (1987) showed that this criterion was useful for testing the first level of understanding. To test the second level of comprehension, the speaker's intention, these authors proposed using situations in which the requested action was/was not accomplished by the listener and participants had to assess the speaker's state of satisfaction or dissatisfaction. In the present study, we went further into this issue by using this stricter criterion (i.e., understanding the speaker's intention) to evaluate request comprehension in head-injured patients with frontal lesions.

In addition to assessing comprehension of conventional indirect requests, we evaluated comprehension of unconventional indirect requests. The distinction between these two request categories was made on the basis of how they are linked to the context: conventional ones are always interpreted as requests, regardless of the context ("Can you pass me the salt?"), whereas unconventional ones are interpreted as requests in certain contexts only ("It's cold" will be interpreted to mean "Close the door" only in a drafty room). Proper comprehension of unconventional indirect requests requires inferential reasoning to make the connection between the form of the utterance and the context.

4.1 Material

The material consisted of 24 stories made up of three photographs (10 cm x 15 cm). It was generated in reference to other tasks already validated in developmental

pragmatics (Bernicot & Legros, 1987), and then pre-tested on ordinary adults so that we could retain the items that were relevant to this population. Each photograph had a typewritten caption below it (in order to avoid comprehension problems, the captions were read aloud by the experimenter and repeated upon request (see 4.2., Procedure). The first photograph showed two people and the request produced by the speaker. The type of request varied: the speaker made either a direct request (8 stories), a conventional indirect request (8 stories), or an unconventional indirect request (8 stories). The direct requests were commands in the imperative ("Close the door"). The conventional indirect requests were embedded imperatives of the type "Can you close the door?" in the interrogative form; the requested action and its agent were explicit. The unconventional indirect requests were hints of the type "It's cold" (to mean "close the door") in the declarative form; the requested action and agent were implicit. The second photograph showed what the listener did upon hearing the speaker's request. For each type of request, the listener satisfied the speaker's request in half the cases (4 out of 8) and did not satisfy it in the other half (4 out of 8). The third photograph showed the psychological state of the speaker after the listener's action, either happy (big smile) or unhappy (frown). For each request type, half of the third photographs showed a happy speaker and the other half, an unhappy speaker. The story examples presented in Table 3 illustrate how the stories were constructed. This material allowed us to test for a high level of request comprehension, insofar as the participants had to understand not only what action was supposed to follow the request utterance but also the speaker's intention.

Insert Table 3

4.2 Procedure

The experimenter seated next to the participant put the photographs on a table and read the written captions out loud while pointing to the different characters. A sample story was proposed before the beginning of the task. The participant had to (1) say whether the proposed ending went with the beginning of the story (comprehension and pragmatic skills), and (2) explain his/her response (metapragmatic knowledge). The task

instructions were as follows: "Here are some photographs that tell short stories. Each time, tell me whether the ending I show you goes with the beginning of the story, and then tell me why." After each story, the experimenter asked the participant: "Does the ending of the story go with the beginning? Why?" The stories were presented in random order. Each control participant saw the stories in the same order as his/her matched patient.

4.3 Coding

Comprehension. Request comprehension (i.e., pragmatic skills) was assessed on the basis of the response to the question "Does the ending of the story go with the beginning?" The correct answer was "yes" when the ending (i.e., the speaker's happy or unhappy state) was consistent with the information given at the beginning of the story, and "no" when the ending was inconsistent. For each request type, the correct answer was "yes" in half of the cases (4 out of 8: two in which the speaker carried out the action and the listener was happy, and two in which the speaker did not carry out the action and the listener was unhappy); it was "no" in the other half (4 out of 8: two in which the speaker carried out the action and the listener was unhappy and two in which the speaker did not carry out the action and the listener was happy). Some examples of responses are given in Table 3.

Metapragmatic knowledge. For each correct comprehension answer, the explanation given by the participant (answer to the question *"Why?"*) was analyzed in order to assess the participant's metapragmatic knowledge. The explanations were sorted into three categories: *missing or nonsensical explanation*, when the participant did not answer the question "Why?" or gave an explanation that seemed illogical or did not make sense; *irrelevant explanation*, when the participant's explanation was about things that were irrelevant to the immediate analysis of the situation, such as some detail about the setting, a reference to his/her personal life, imaginary dialogues, or a hypothesis about a person in the photograph; and *relevant explanation*, which stated why the information given at the beginning of the story (about the speaker's request) was consistent or inconsistent with the information given in the ending. Relevant explanations relied on the

cues supplied in the experimental material. Some examples of explanations are presented in Table 4.

Two independent coders rated 10% of the corpus: the inter-coder agreement rate was .86. Only relevant explanations (not missing/nonsensical or irrelevant ones) were analyzed: these responses were indicative of a high comprehension level and metapragmatic knowledge about language use.

Insert Table 4

4.4 Results

Comprehension. Figure 3 gives the mean number of correct answers given by the participants in each group, for each type of request (direct, conventional indirect, unconventional indirect). The statistical analysis (Mann-Whitney U) yielded a nonsignificant group effect: regardless of the type of request, the patients gave as many correct answers as the controls. Request type did not have a significant effect in either group (Friedman's ANOVA): patients as well as controls gave an equal number of correct answers for the three types of requests. This lack of an effect is related to the very high number of correct answers (7 or 8 out of 8).

Insert Figure 3

Metapragmatic knowledge. Figure 3 also gives the per-participant mean number of correct answers that were followed by a relevant explanation, for each group and request type. The statistical analysis (Mann-Whitney U) yielded a significant group effect: regardless of the type of request, the patients gave fewer correct answers followed by a relevant explanation than did the controls (direct requests: $U = 26.5$, $p < .03$; conventional indirect requests: $U = 27.5$, $p < .03$; unconventional indirect requests $U = 19.5$, $p < .007$). In both groups, the request-type effect was nonsignificant (Friedman's ANOVA): the patients and controls alike gave an equal number of correct answers followed by a relevant explanation for the three types of requests. This number was about 7 for the controls and 5 for the patients.

Comparison of comprehension and metapragmatic knowledge. The effect of the task (comprehension vs. metapragmatic knowledge) was significant for the patients on all three types of verbal requests (Friedman's ANOVA): patient performance was better on comprehension (almost perfect) than on metapragmatic knowledge (direct requests, $z = 2.04$, $p < .04$; conventional indirect requests, $z = 2.27$, $p < .02$; unconventional indirect requests, $z = 2.47$, $p < .01$). This difference only existed for the controls (who got very high scores on both tasks) on conventional indirect requests ($z = 2.27$, $p < .02$).

5. Patients' Individual Profiles: Qualitative Analysis

Now that we have these initial group results, let us look at the patients' individual profiles (as compared to their matched controls) in the areas corresponding to their weak points, namely, the percentage of topic-maintaining speaking turns and the percentage of digressing speaking turns during *production* (Figure 4), and the number of correct answers followed by a relevant explanation on the *metapragmatic knowledge* test (Figure 5). What we want to find out here is whether these weaknesses are exhibited by all patients or only some, and whether a given patient has a uniform overall functioning level or exhibits both strengths and weaknesses in language use.

Insert Figures 4 and 5

For each patient, Table 5 indicates whether his/her performance on each task was labelled as a strength (shown as a plus sign) or a weakness (shown as a minus sign). The strengths and weaknesses of each participant were determined by jointly considering two elements: (1) the score of that participant's control, and (2) the distribution of the scores for the two groups. For topic maintenance and metapragmatic knowledge, a patient's score was considered to correspond to a strength if it was 75% or more of his/her matched control's score or was above the mean of the two groups pooled (patients and controls); it was labelled as a weakness if it was less than 75% of the control's score or was below the mean of the two groups. Inversely, for digressions, a patient's score was

considered to correspond to a strength if his/her control's score was at least 75% of the patient's score or if the patient's score was below the mean of the two groups pooled; it was labelled as a weakness if the control's score was at least 75% of the patient's score or if the patient's score was above the mean of the two groups.

Insert Table 5

Table 5 clearly brings out the differences between the tasks: the highest number of patients who had difficulty was found for topic maintenance (10 out of 11 patients). This was followed by digressions and metapragmatic knowledge (6 patients in each case).

This table also indicates some profile differences across patients. Patient P10 had no weak points, and patients P2, P3, and P11 had only one (out of three): topic maintenance. Patients P6, P7, and P8 had the greatest number of weaknesses (three out of three). Finally, the performance of patients P1, P4, P5, and P9 was intermediate, with two weak points: topic maintenance and metapragmatic knowledge, or topic maintenance and digression.

6. Discussion

The aim of this study was to test French-speaking individuals with traumatic brain injury and frontal damage, in view of assessing their linguistic abilities in different domains: production (interview), comprehension (verbal requests), and metapragmatic knowledge. What answers did this comparison of three tasks provide to the questions raised here about the strengths and weaknesses of patients and their interindividual differences? The results pointed out non-uniform alterations, that is, a given patient could have both strong points and weak points in these different areas.

6.1 Results for Production, Comprehension, and Metapragmatic Tasks

First task (production: interview). This task allowed us to conduct an in-depth analysis of the conversations of patients with traumatic brain injury, in order to answer the following question: To what extent are these patients able to abide by the basic structure of an exchange while being impaired at maintaining the topic of conversation?

Concerning the first point — the structure of the exchange — the two groups (patients and controls) obtained the same results. Looking at the respective contributions of the participant and experimenter, there was no significant difference between the two groups on either of the speech-quantity indexes (number of speaking turns and number of utterances). Thus, the standard interview format was followed, insofar as the interviewee (the participant) spoke more, as a whole, than the interviewer (the experimenter). This was true for both indexes in the control group, but only for the number of utterances in the patient group. These findings provide evidence of the ability of people with traumatic brain injury to abide by the conversational structure, and they confirm the results already obtained by Angeleri et al. (2008): patients seem to be able to engage in a well-structured exchange for 6 to 16 minutes on a specific, simple topic (here, favorite animals and singers) proposed by someone else. Note that in the Angeleri et al. (2008) study, the topics addressed were similar, but the conversations were a little shorter (4 to 6 minutes). We can nevertheless wonder about the impact of the methodology used in the two studies, and more specifically, about the type of conversation proposed to the participants. In our experiment, the conversation was clearly focused on two main topics right from the beginning of the interview; this may be what structured the exchanges and could account for the nearly identical participate/experiment turn-taking organization in the two groups. As stressed by Angeleri et al. (2008), this factor can have an impact during freer, more "ordinary" types of conversation where various topics and subtopics have to be developed. This idea was supported in a study by Bond and Godfrey (1997), who showed that patients experienced difficulties in situations of free conversation.

Concerning the second point — topic maintenance during a conversation — our results showed that for this type of exchange, the patients differed from the controls in two respects: they had trouble maintaining the topic of conversation after a silent period in the exchange, and they had a hard time avoiding digressions. Digressions by typical participants were practically nonexistent. These results are in line with the conclusions of

our earlier work on traumatic brain injured adolescents (Bernicot & Dardier, 2001), and at a more general level, they confirm the findings of other studies on adults with a traumatic brain injury (Snow et al., 1995).

The present findings support the idea that tasks in which participants must not only organize the content of their speaking turns, but also continuously make adjustments to their discourse to meet the demands of the interlocutor, can serve as "natural" tasks for assessing the disabilities of frontal-lesioned individuals in situations of language production (Bernicot & Dardier, 2001). The ability to carry out a successful exchange on a specific topic requires the speaker to take initiatives, understand the primary and secondary goals of the conversation, and plan the steps needed to construct a coherent argumentation. Moreover, developing the principal topics must remain the ongoing focus, and the speaker must be capable of assessing the relevance of his/her discourse so as to modify its content and avoid digressions. The comparison of our patients' results on the production task and on the neuropsychological tests did not bring out any systematic links between these two domains. These findings suggest, however, that conversation analysis is a highly sensitive way of assessing frontal-lesioned individuals and can supply additional information to supplement initial neuropsychological evaluations. It can also point out major communication disorders undetected by traditional language tests. On this point, we agree with Penn, Frankel, Watermeyer, and Russell (2010), for whom the study of conversations is a good approach for analyzing executive functions in context. Lastly, in future research, other indexes could be used to supplement this initial analysis, e.g. hesitations, repetitions, or the use of connectives and fillers. Video recording could also be used to evaluate participants' nonverbal behaviors (e.g., head shaking and nodding, looking, smiling), which may be critical to successful communication.

The *comprehension task* was used to assess the understanding of various types of requests, including one type that has hardly ever been studied in patients with a head injury: unconventional indirect requests or hints (for example, "It's cold" to mean "close the window"). Moreover, we used a comprehension criterion that was stricter than simply knowing what action was to be carried out: understanding the speaker's intention. The results showed that the patients did not differ here from the controls. Indeed, there were no significant differences between the two groups on conventional indirect requests

("Can you make me a cup of coffee") or on hints (nearly perfect performance). Thus, our first hypothesis was not validated. The fact that we used a stricter criterion to assess comprehension, namely the speaker's intention (rather than the action being carried out), did not pose a problem for patients when it came to understanding the different types of requests. This result confirms those already obtained for unconventional indirect requests (with a different measure of comprehension) by Angeleri et al. (2008), Bara et al. (1997), and McDonald (1992). In addition, we expected the patients to have more trouble understanding complex request forms (hints), yet this type of utterance was well understood by our patients. As underlined by McDonald (1999), this finding suggests that the discrepancy might be due to the material used; by presenting the setting and indicating whether or not the speaker's request was satisfied in the end, we may have made the utterances easier to understand. Our use of short stories and photographic material, and the breakdown of the story by the experimenter (who stated each step of the situation) may have facilitated comprehension of conventional and unconventional indirect requests from the standpoint of the speaker's intention. The procedure used, then, could account for the ceiling effect obtained on this task for all patients. We can also explain this finding by recalling that, from the point of view of development, children succeed on comprehension tasks first, before tasks involving production or metapragmatic knowledge. The fact that the cognitive mechanisms underlying these tasks are acquired earlier may make them more “robust" when it comes to "resisting" pathologies, particularly front-brain lesions.

An *evaluation of metapragmatic knowledge* supplemented our analysis of request comprehension (pragmatic aspects). Here, our idea was to determine whether the participants could understand the utterances produced in the communication situations proposed (pragmatic skills), and also whether they were capable of explaining how these different request types work (metapragmatic skills). The metapragmatic data we obtained indicated poorer performance for the patient group than for the control group. The performance of the typical participants was not perfect, but was very high (75%-100% correct answers). Among the patients, the ability to express knowledge about the various types of requests was clearly impaired. These results are consistent with the views of McDonald and Pearce (1998), for whom patients sometimes exhibit only a partial

understanding of complex utterances and communication situations; they support the idea that these patients may only understand this type of communication situation on the surface. On this point, as advocated by Channon et al. (2005), it is necessary to analyze the explanations given by such patients in order to make sure that they truly understand the situations proposed.

6.2 Strengths and Weaknesses

Based on the results obtained by the patients and control participants on the different tasks, we were able to show that the traumatic brain injured adults exhibited both strengths and weaknesses in language use. Concerning the comparison across tasks, it is important to note that the three tasks did not call upon the same pragmatic skills. The production task (interview) "directly" mobilized the participants' conversational know-how (abiding by turn-taking rules, developing the topic, avoiding digressions, inferring the changing intentions of others during the conversation, etc.). The patients' results on this first task showed that, as a whole, the exchange structure was well-preserved; this was one of their strong points. Their weak points in this area were their poor ability to maintain the topic of conversation on consecutive speaking turns, and the large number of digressions made. The comprehension task brought out one of their strong points: understanding the speaker's intention in conventional and unconventional indirect requests. The traumatic brain injury group had no trouble with this task and performed it as well as the control group did. This good performance could be due to our experimental procedure, or to the early acquisition of the underlying cognitive processes during development. Regarding metapragmatic knowledge, no matter what type of request was proposed, performing this task was one of the patients' weak points. Compared to typical participants, the patients were less able to express their knowledge about the relationship between the structural characteristics of an utterance and those of its social context of production. The cross-task comparison indicating the patients' good comprehension of requests, along with their difficulty expressing metapragmatic knowledge, suggests that traumatic brain injured people differ from typical individuals in their ability to "explain the world". Our comparison of three tasks thus proved to be quite relevant, in that it

showed how a brain lesion following a traumatic head injury can severely but differently impair the language abilities acquired in the course of development.

6.3 Interindividual Differences

Our analysis of interindividual differences was based on the patients' strengths and weaknesses, as determined by comparing their scores with their respective controls and with the score distribution of the two groups. This analysis revealed different groups of patients and different patterns of performance: one patient did well in all areas (P10), three patients (P2, P3, P11) were deficient in topic maintenance only, three patients were impaired on all tasks (P6, P7, P8), and four fell in-between (P1, P4, P5, P9). This substantial performance heterogeneity has already been noted in other populations of brain-damaged patients, notably among patients with right lesions (Champagne & Joanette, 2009; Champagne, Nespoulous, & Joanette, 2002). It is not possible here to give "definitive" explanations for these differing profiles. However, looking at the profiles of the least impaired and the most impaired patients, three factors seem to enter into the picture: the patient's current age and the time elapsed since the traumatic brain injury occurred, the characteristics of the lesion, and the patient's neuropsychological profile as assessed on executive-function tests (gender, education, or handedness do not seem to play a role).

Patient's current age and time since injury. Except for patient P3 (age 38), most of the patients with spared pragmatic and metapragmatic skills (P2, P10, P11) were young (ages 24, 18, and 20) and had undergone a traumatic brain injury during childhood. Note that the most impaired patients (P6, P7, P8) were older (ages 39, 36, and 46). None of the young patients fell into the most impaired category. Work on young brain-injured patients has shown that their disabilities mostly concern their social skills, and tend to persist or worsen with age (Landry, Swank, Stuebing, Prasad, & Ewing-Cobbs, 2004; Chapman, Levin, & Lawyer, 1999). Our data are not in line with this conclusion, in that we found some patients whose severe traumatic brain injury had occurred during childhood but who still exhibited certain spared pragmatic skills in adulthood. This finding raises the question of what associated factors are likely to act as

"protective" mechanisms; it also stresses the need for life-span studies aimed at understanding this interindividual variability. From an epidemiological point of view, children, adolescents, and young adults represent a large proportion of people with traumatic brain injury, yet age at the time of injury is not always considered in work on pragmatic deficits in adult patients. Taking this factor into account, as well as conducting longitudinal studies in the area of social cognition, should help gain insight into the varied and complex developmental paths of such patients.

Lesion characteristics. Does a description of lesions caused by a traumatic brain injury offer new possibilities for interpreting interindividual differences? People with severe traumatic brain injury often have damage located in a wide variety of brain regions, so it is usually difficult to compare lesion sites across studies. However, searching for brain-damage profiles that share lesion size and site should bring some information into the picture. Indeed, looking simply at the four least-impaired patients in our study (P2, P3, P10, P11), we can see that they all had unilateral lesions (on the left for patient P2, on the right for the other three patients). Among the most deficient patients, two had bilateral lesions (patients P6 and P8) and one had unilateral right-brain damage (patient P7). None of the patients with bilateral brain damage fell into the least impaired category. Lesion size is known to be an important factor in intensifying the deficits of brain-injured patients, a finding that was confirmed in our study. Concerning the role of lesion side, many studies have shown that the right hemisphere is involved in language pragmatics, both for conversation (Brady et al., 2006; Chantraine et al., 1998; Joanette et al., 1990) and for request comprehension (Champagne-Lavau & Joanette, 2009; Champagne, Virbel, Nespoulous, & Joanette, 2003; Cutica, Bucciarelli, & Bara, 2006; Foldi, 1987; Stemmer, Giroux, & Joanette, 1994; Weylman, Brownell, Roman, & Gardner, 1989). Our results are not as clear-cut on this question because right unilateral lesions were present not only among the most deficient patients (e.g., patient P7) but also among the ones who performed well on several tasks (e.g., patients P3, P10, P11). As McDonald (1993) stressed, in addition to the hemispheric account, it is important to consider the presence or absence of frontal lesions in interpreting a patient's outcomes. On this point, the role of the prefrontal cortex (particularly the ventromedial areas), as mentioned in various studies on social cognition (Bechara, Damasio, Tranel, &

Anderson, 1998; Channon, Rule, Maudgill, Martinos, Pellijeff, Frankl, Drury, & Shieff, 2007; Kreuger, Barbey, & Grafman, 2009; Shamay-Tsoory, Tomer, & Aharon-Perez, 2005), should also be considered. The recent neuroimaging study by Yang, Fuller, Khodaparast, and Krawczyk (2010) showed that the left inferior frontal gyrus was underactivated in traumatic brain injured patients during figurative language processing. It would be worthwhile in the future to try to find out whether the particularities found in our patients are specific to individuals with focal frontal lesions.

Neuropsychological test scores. The tests used here to assess executive functions also brought out highly variable performance across patients, and in this respect, our findings are in line with Kennedy et al. (2008), for whom "disorders of executive functions are as heterogeneous as the TBI population itself" (p. 259). Among the principal neuropsychological disorders observed, five out of eleven of our patients had reduced phonemic fluency (P2, P3, P4, P9, P11) and four had mental flexibility problems on the Trail Making Test (P2, P4, P5, P6). The other tests did not bring out any major difficulties, since only patient P1 failed on the Wisconsin Test, and only patient P2 had trouble with Stroop inhibition. These results again raise the question of the role of the frontal lobes in executive functioning, particularly the implication of the various regions of the prefrontal cortex. Frontal lesions are known to be frequent following traumatic brain injury, and various studies cited above (Douglas, 2010) mention an association between executive dysfunction and pragmatic deficits among persons with traumatic brain injury. As Cabeza and Nyberg (2000) stressed, in order to go more deeply into this issue, executive processing needs to be considered not as a whole, but as a set of distinct processes that depend on different regions of the prefrontal cortex, each potentially playing a different role in language production and comprehension in context (Channon & Watts, 2003). Was this true of our patients, all of whom had front-brain damage? Let us compare Table 2 showing the patients' scores on the neuropsychological tests assessing executive functions, and Table 5 showing their individual profiles on the pragmatic and metapragmatic tasks. Among the four patients who showed no executive impairment (P7, P8, and P10), only P10 got good scores on all three pragmatic and metapragmatic tasks; patients P7 and P8 got poor scores on all three tasks. If we look instead at the patients who had the best pragmatic and metapragmatic performance (P2,

P3, P10, and P11), the link is still not perfect: while patient P10 had no executive deficit, P2 was deficient in three executive tests out of four (P3 and P11 were difficult to interpret because their executive-test results were missing). One can raise the question of how the various cognitive processes underlying executive functions (inhibition, mental flexibility) affected the performance of our patients, but the neuropsychological data collected here do not allow us to draw any definitive conclusions about these implications. All in all, then, an important result of this study remains the absence of a clear link between pragmatic (and metapragmatic) deficits and executive dysfunction.

The patients had executive function profiles that differed in the degree of impairment in the domains considered. Added to the contrasting profiles were differing patterns of strengths and weaknesses in the pragmatic and metapragmatic domains. It seems that experimental paradigms designed in the framework of pragmatic theories may be able to detect subtle difficulties that do not show up on traditional neuropsychological tests (Bernicot & Dardier, 2001; McDonald & Pearce, 1998). Additional studies on the pragmatic/executive link are needed, with larger and more homogeneous samples of patients (in terms of age, brain-injury severity, age at time of damage, etc.) and more natural methods of executive-function assessment (Douglas, 2010). Lastly, as mentioned above in the introduction, another hypothesis often advanced to explain pragmatic difficulties is the potential role of a theory of mind (TOM), i.e., an impaired ability to attribute mental states (Bibby & McDonald, 2005; Martin & McDonald, 2003). Recent data gathered from right-lesioned patients has shown that a TOM disorder associated with an executive deficit (deficient inhibition or a lack of flexibility) is a much greater predictor of the pragmatic impairment found in patients than is executive dysfunction alone (Champagne-Lavau & Joanette, 2009). Moreover, the impact of a TOM deficit on pragmatic skills has been described in studies on other disorders (such as schizophrenia: Brune & Bodenstein, 2005; Champagne-Lavau & Stip, 2010). The link between TOM and pragmatic (metapragmatic) performance among front brain-damaged patients could be a highly fruitful avenue for future research.

6.4 Conclusion

Our work brought out the existence of different pragmatic and metapragmatic profiles among our patients. This finding is an important point to consider in designing rehabilitation programs. Indeed, knowing whether certain capacities can be mobilized is a prerequisite for defining good therapy. In our study, some patients had trouble following the rules of conversation, while others were impaired in explaining the interaction situations proposed in our tasks. Furthermore, various studies have stressed that assessments made in research situations (whether clinical or experimental) do not always reflect the true abilities that patients would exhibit in real-world settings (Kilov, Togher, & Grant, 2009; Turkstra, 2008). Yet therapy programs must target not only any difficulties observed in "standard" assessment contexts, but also those experienced in daily life. It thus seems indispensable in the future to administer tests that are as natural as possible (Coelho, Ylvisaker, & Turkstra, 2005). According to Togher, McDonald, Code, and Grant (2004), it is also important to work directly with the persons who are the patients' everyday interlocutors, insofar as their attitudes often have an impact on the behavior of persons with traumatic brain injury. All of these elements must be brought to bear in designing and setting up remediation programs.

After brain damage, subtle language disorders without aphasia may arise in persons with a frontal-lobe lesion. Our analysis of the patients' profiles suggests a high degree of heterogeneity in the communication disorders of these individuals, as noted in other studies of right brain-damaged patients (Champagne et al., 2004; Champagne, Nespoulous, & Joanette, 2002; Harden, Cannito, & Dagenais, 1995). For McDonald, Flanagan, Martin, and Saunders (2004), "Not all people who suffer severe traumatic brain injuries would be expected to have problems with social perception" (p. 288). In the social cognition literature, various domains have been explored with head-injured patients, including pragmatic skills and theory of mind, but also the identification of emotions (for a review, see Knox & Douglas, 2009). Future work will need to investigate the links between these different fields of research. Some promising research avenues in neuropragmatics include developing new experimental paradigms (in different languages) based on pragmatic theories, taking individual differences between head-injured patients into account, and finally, determining what capacities are spared.

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Table 1

Characteristics of the patient population

Patient	Age (years)	Lesion Site	Gender	Time Since Injury (years)	Educational level	Handedness
P1	38	Left frontotemporal	M	2	PhD degree	Right
P2	24	Left frontotemporal	M	16	Less than high school	Left
P3	38	Right frontotemporal	M	6	Less than high school	Right
P4	40	Right frontotemporal	M	7	Some university	Right
P5	49	Bilateral frontal	M	2	PhD degree	Right
P6	39	Bilateral frontal Right parietal	M	12	High school diploma	Right
P7	36	Right frontal	M	12	High school diploma	Right
P8	46	Bilateral frontal	F	5	High school diploma	Right
P9	22	Right frontal	M	5	Less than high school	Right
P10	18	Right frontotemporal	M	6	Less than high school	Right
P11	20	Right frontotemporal	M	7	Less than high school	Right

Table 2

Performance of patients on neuropsychological tests assessing executive functions. Performance in the normal range is shown against a white background, and deficient performance is shown against a light-gray background

NA = Not Available

TESTS	**Patient Scores**										
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11
Phonemic Fluency	15	8	7	9	16	20	13	16	9	15	11
Wisconsin Card Sorting Test	4	6	6	6	6	6	6	6	5	6	4
Categories	4	1	0	2	1	0	0	0	1	0	3
Perseveration											
Stroop											
Reading (T Score)	46	22	**NA**	36	46	42	51	44	42	45	**NA**
Naming (T Score)	44	23	**NA**	45	40	44	46	50	32	40	**NA**
Interference (T Score)	54	21	**NA**	31	42	48	57	40	43	43	**NA**
Trail Making Test											
Part A (time)	14	71	51	56	44	67	24	21	21	30	**NA**
Part B (time)	42	174	111	174	128	125	41	78	51	70	**NA**

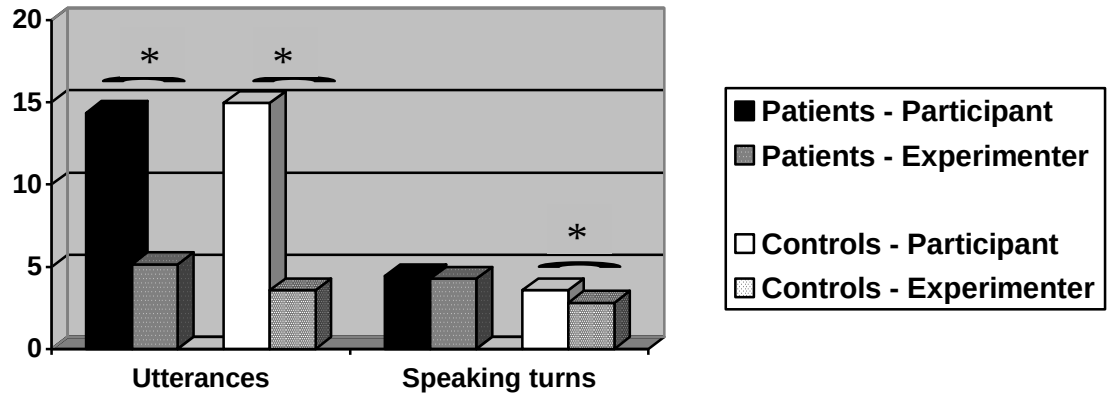

Fig. 1. Production (interview): mean number of utterances per minute and mean number of speaking turns for the participants speaking to experimenter and the experimenter speaking to participant, by group. Asterisks indicate significant differences.

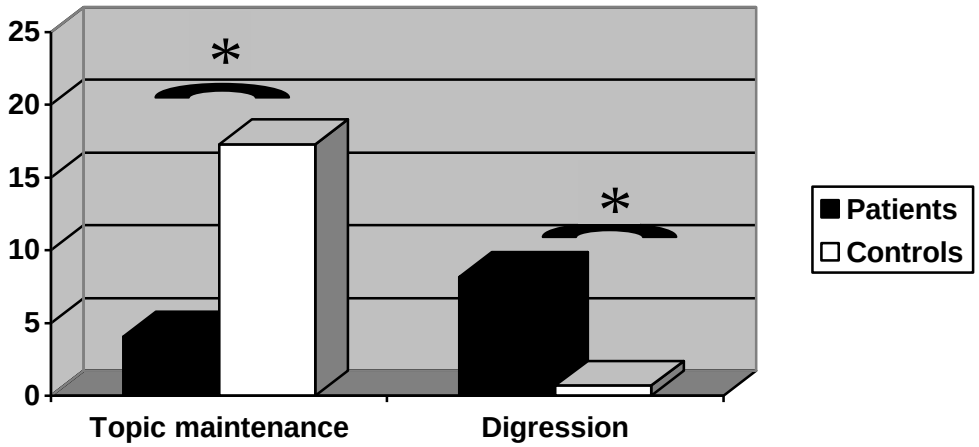

Fig. 2. Production (interview): mean per-participant percentage of topic-maintaining speaking turns without experimenter intervention and digressing speaking turns (with respect to the total number of speaking turns), by group. Asterisks indicate significant differences.

Table 3

Examples of stories (comprehension and metapragmatic knowledge task), by type of verbal request

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Direct request

First photograph: A couple is seated at a table and the woman says, "Wear your glasses when you read."

Second photograph: The man is reading without his glasses.

Third photograph: The woman is not happy.

Correct answer to the question *"Does the ending of the story go with the beginning?"*: YES

Conventional indirect request

First photograph: A couple in a living room. The woman says, "Can you pass me the remote control?"

Second photograph: The man gives her the remote control.

Third photograph: The woman is not happy.

Correct answer to the question *"Does the ending of the story go with the beginning?"*: NO

Unconventional indirect request

First photograph: A couple in a living room. The man is playing the drums. The woman says, "I have a terrible migraine."

Second photograph: The man is playing the drums.

Third photograph: The woman is happy.

Correct answer to the question *"Does the ending of the story go with the beginning?"*: NO

Table 4

Examples of correct answers followed by explanations, for the stories in Table 2 (comprehension and metapragmatic knowledge task, by type of verbal request)

Correct answer followed by a nonsensical explanation (remote-control story, correct answer "no")

Experimenter: Does the ending of the story go with the beginning?

Participant: That's not logical, it's no good *(the participant answers "no")*. And it's just like they say about couples watching television, it can cause a problem in any couple ...

Correct answer followed by an irrelevant explanation (glasses story, correct answer "yes")

Experimenter: Does the ending of the story go with the beginning?

Participant: Well yes *(the participant answers yes)*. He's not listening! And he spent a fortune on his glasses and he doesn't even wear them! It's unthinkable! "Besides, can you believe it, Marcel, they're not even covered by our health insurance!" *(the participant imagines a dialogue between the characters)*

Correct answer followed by a relevant explanation (drums story, correct answer "no")

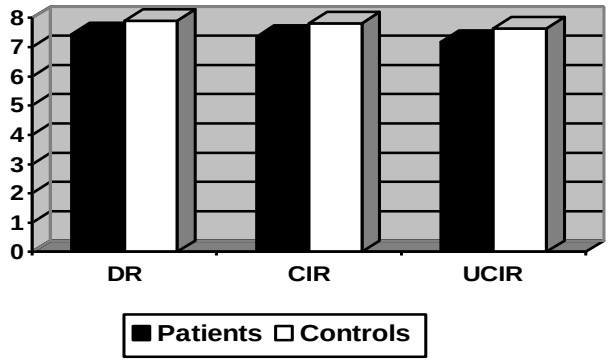
Experimenter: Does the ending of the story go with the beginning?

Participant: Obviously it's no good *(the participant answers no)*.

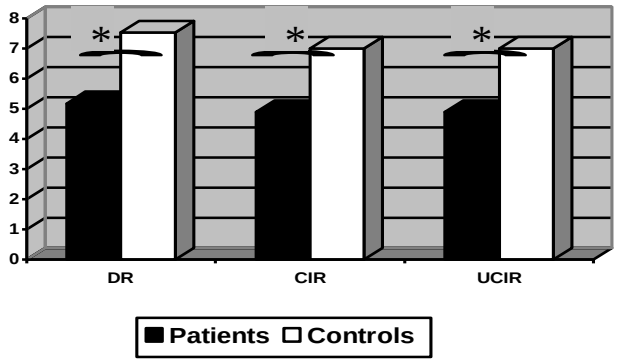
Experimenter: Why?

Participant: Because he obviously didn't take her situation into account, it's true, and so she should express her discontent, her headache that's gotten much worse.

Request comprehension: Number of correct answers (per-participant mean out of 8)



Metapragmatic knowledge: Number of correct answers followed by a relevant explanation (per-participant mean out of 8)



Comparison between request comprehension and metapragmatic knowledge

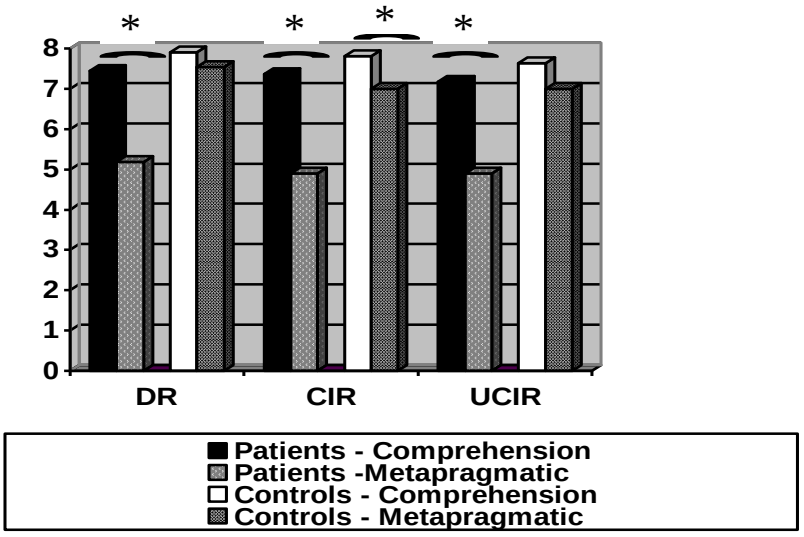
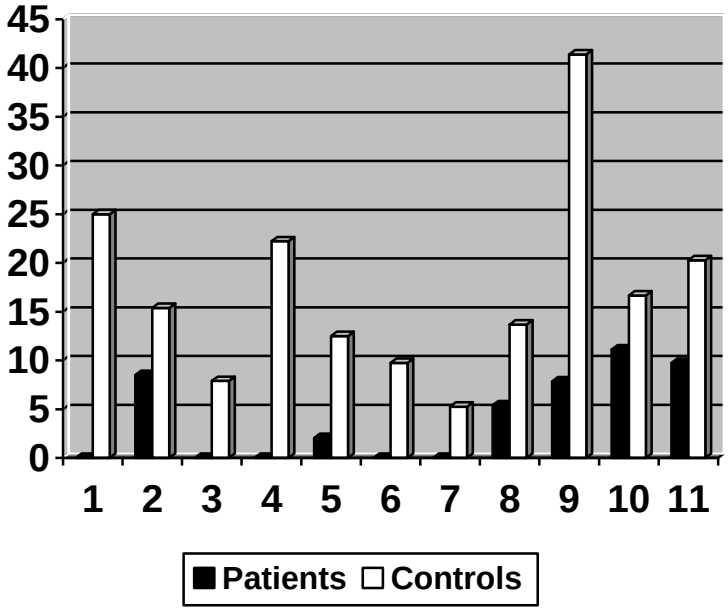


Fig. 3. Request comprehension and metapragmatic knowledge in the two groups, by type of request. Asterisks indicate significant differences.

DR = direct requests, CIR = conventional indirect requests, UCIR = unconventional indirect requests

Percentage of topic-maintaining speaking turns



Percentage of digressing speaking turns

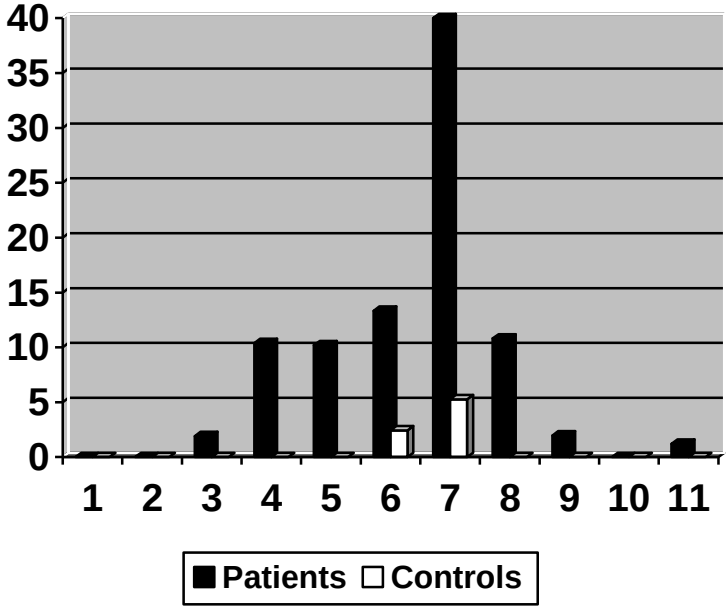


Fig. 4. Production: percentage of topic-maintaining speaking turns and percentage of digressing speaking turns, by participant (patients and controls).

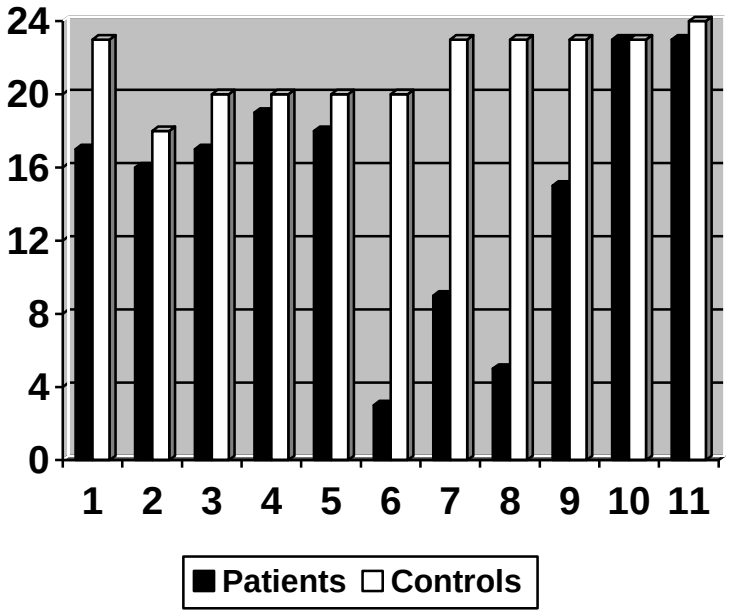


Fig. 5. Metapragmatic knowledge: mean number of correct answers (out of 24) followed by a relevant explanation, by participant (patients and controls), for all types of requests pooled (direct, conventional indirect, and unconventional indirect).

Table 5

Individual profiles of patients on the tasks where the patient group, as a whole, had poorer performance than the control group (patient score/control score). Strengths are shown as a plus sign (+) on a white background and weaknesses are shown as a minus sign (-) on a light-gray background.

Patient	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11
Production: topic-maintenance score	-	-	-	-	-	-	-	-	-	+	-
Patient/Control	0/ 25	8.51/ 15.38	0/ 7.89	0/ 22.22	2.04/ 12.50	0/ 9.75	0/ 5.26	5.4/ 13.69	7.84/ 41.39	11.11/ 16.66	9.75/ 20.27
Mean=10.66											
Production: digression score	+	+	+	-	-	-	-	-	+	+	+
Patient/Control	0/ 0	0/ 0	1.92/ 0	10.38/ 0	10.20/ 0	13.33/ 2.93	40/ 5.26	10.81/ 0	1.96/ 0	0/ 0	1.21/ 0
Mean=4.43											
Metapragmatic knowledge score	-	+	+	+	+	-	-	-	-	+	+
(role of request type)	17/ 23	16/ 18	17/ 20	19 /20	18 /20	3/ 20	9/ 23	5/ 23	15/ 23	23/ 23	23/ 24
Patient/Control											
Mean=18.27											